WALSON ARMY COMMUNITY HOSPITAL

FORT DIX, NEW JERSEY

ENERGY ENGINEERING ANALYSIS PROGRAM

FOR

DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT CORPS OF ENGINEERS

1984

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Marie Wakefield,
Librarian Engineering

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A. INTRODUCTION

PURPOSE

In September of 1984, the firm of Einhorn Yaffee Prescott, P.C. was retained by the Army Corps of Engineers to perform energy conservation services for the Walson Army Community Hospital at Fort Dix and the Ainsworth Clinic at Fort Hamilton. The architectural/engineering/health planning field team studied the existing heating, ventilating, air conditioning, and electrical systems, results of all prior or ongoing energy conservation studies, projects, and designs or plans, the facilities operation and environment, and past energy usage. A comprehensive report has been prepared which documents the work accomplished, the results and the recommendations. This report reflects a joint effort between the field investigation team and the hospital staff. The scope of this study included the following objectives:

- Perform a complete energy audit and analysis of the entire hospital facility.
- Identify all energy conservation opportunities, including low cost/no cost items and perform complete evaluations of each.
- Prepare programming documentation for all energy conservation investment program projects including DD Form 1391, a life cycle cost analysis summary sheet with backup calculations and a Project Development Brochure.
- Prepare implementation documentation for all justifiable energy conservation opportunities.
- List and prioritize all recommended energy conservation opportunities.

APPROACH

The methodology through which this study was conducted consisted of several steps:

1. The field investigation team began with a review of existing building plans and previous energy studies and projects provided by the Corps of Engineers, hospital staff, and Directorate of Engineering and Housing (DEH). The documents reviewed include:

   - Energy Engineering Analysis Program, Fort Dix, New Jersey; Increment F, January 1984. Prepared for the Baltimore District Corps of Engineers by PRC Systems Services Company, Cocoa Beach, Florida.
   - Department of the Army Productivity Improvement Program, regulation AR 5-4, August 1, 1982.
   - ETL 1110-3-282, February 10, 1978, Energy Conservation.
   - ETL 1110-3-326, September 25, 1981, General Criteria for Medical Facilities.
   - ETL 1110-3-332, March 22, 1982, Economic Studies.
   - ETL 1110-3-335, November 22, 1982 General Planning/Design Criteria for Medical Facilities.
   - ETL 1110-3-344, October 4, 1983, Interior Mechanical Design Criteria for Medical Facilities.
   - ETL 1110-3-345, October 14, 1983, Heat Transfer Valves.
   - TM5-785, July 1, 1978, Weather Data (in part).
   - Army Facilities Energy Plan, November 17, 1983.
   - Applicable codes including Joint Committee for Accreditation of Hospitals (JCAH), Occupational Safety and Health Act (OSHA) and the National Fire Protection Association (NFPA) Life Safety Code.

2. A field team consisting of architects, electrical and mechanical engineers, control specialists, health planners, and energy audit technicians spent two weeks in the field gathering data and inspecting the facility. The results of this audit are documented in this report.

3. With the above information, a list of potential energy conservation opportunities was developed. These measures were computer analyzed using the Building Loads Analysis and Systems Thermodynamic (BLAST) program. This program incorporates field survey data, weather data, occupancy schedules, building construction data, energy distribution and systems data into a model of the total facility.

4. A comprehensive report was prepared, meeting the objectives of this study and providing the Fort Dix Walson Army Community Hospital with a useful instrument for reducing energy consumption.

GENERAL BUILDING CHARACTERISTICS

The Fort Dix Walson Army Community Hospital was constructed in 1961. The building consists of nine floors and a basement in the original hospital area and two floors and a basement in the newer clinic area. The walls are a brick and block construction with a 1/2 inch of interior insulation. The roof is flat and consists of built-up roofing covered with stone on the original structure and built-up roofing with stone and 2 inches of rigid insulation above the clinic section. The ceilings are suspended tile or plaster. The windows are primarily double glazed and tinted.

The primary heating and air conditioning system is a two-pipe induction air system. This system consists of two roof mounted built-up air handling units that supply 100% fresh air to the induction units via medium pressure ductwork. The induction units are equipped with filters, coils and two-way control valves. Chilled water is provided to the air handling and induction units from a chiller plant remote from the building. Domestic hot water and heating hot water are provided by heat exchangers utilizing steam from a remote boiler facilities. Automatic temperature controls are pneumatic with dual pressure heating/cooling control capability.

The operating rooms are equipped with individual air conditioning systems consisting of air handling units, spray systems for humidification, air-cooled chillers, and filtration equipment. The units are designed to operate on 100% fresh air.

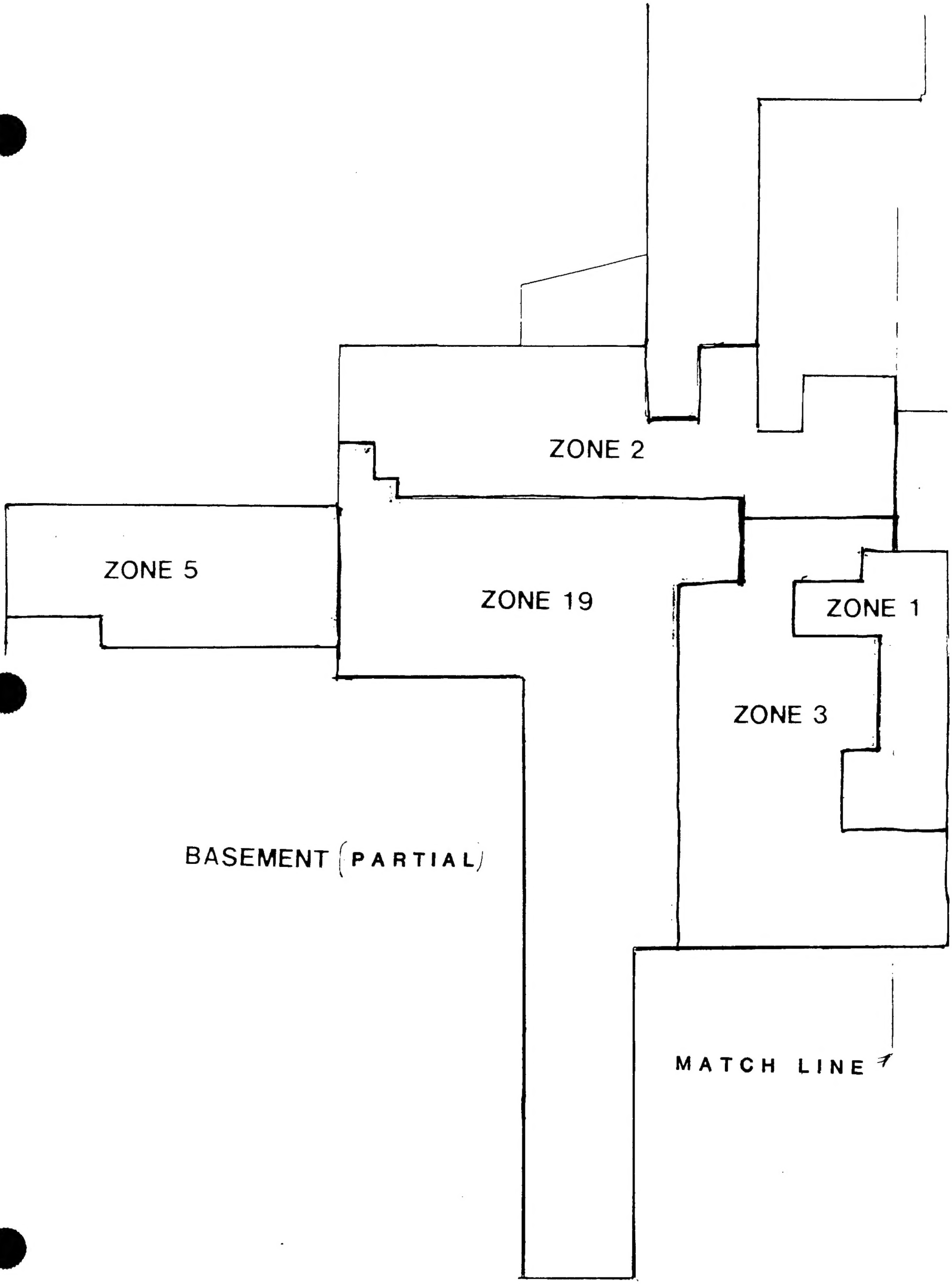
Clinic heating and air conditioning is provided by a constant volume, reheat system utilizing steam for reheat.

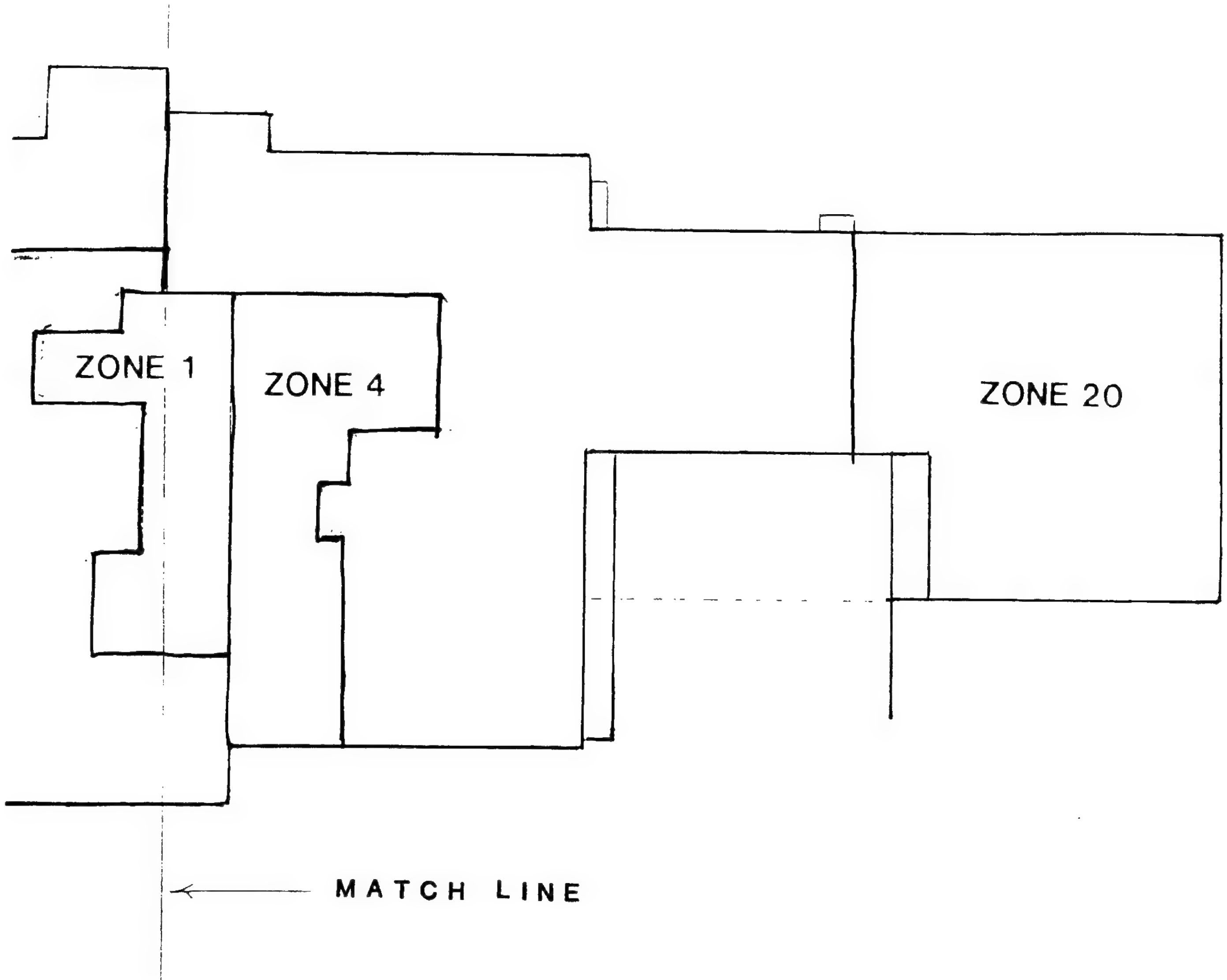
ZONE DESCRIPTIONS AND DIAGRAMS

It was necessary to divide the building into unique zones for modeling purposes. Zones were specified on the basis of areas served by each system, or group of systems with similar characteristics and control strategies. The table on page A-6 provides a list of zones and equipment parameters. The area served is listed as shown on the original building zoning schedules. Use of several areas has since changed. Zone numbers refer to the zoning diagrams in this report. Simplified floor plans showing the zone boundaries are found on pages A-7 through A-13.

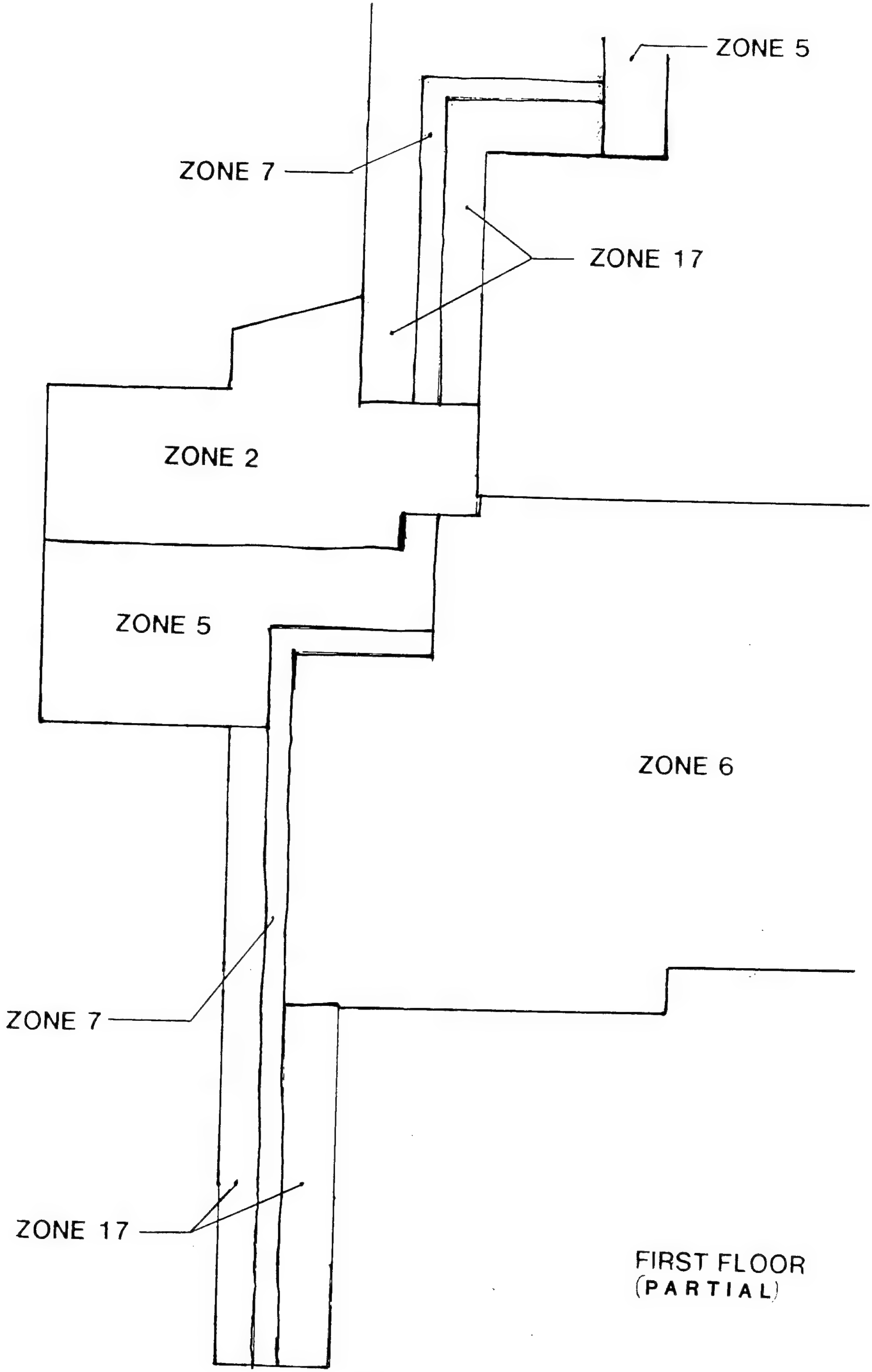
ZONE NO.	AREA SERVED	SYSTEM NO.	TYPE	CFM	HOURS OF OPPERATION
1	Dishwashing	BL1	Supply	5,620	0600-1700
2	Interior Areas	BL2	Supply	14,350	24 HR.
3	Dining Room	BL3	Supply	15,160	24 HR.
		EXH29	Return	7,100	24 HR.
		EXH3	Exhaust	13,375	24 HR.
4	Kitchen	BL4	Exhaust	17,375	0600-1900
		E4	Exhaust	17,375	0600-1700
5	Assembly Areas	BL5	Supply	14,940	24 HR.
		EXH5	Return	10,455	24 HR.
6	OPD and Old Clinic	BL6	Supply	46,540	24 HR.
		EXH6	Return	36,600	24 HR.
7	Corridors	BL7	Supply	9,620	24 HR.
8	Operating Rooms 1&2	BL8	Supply	1,260	24 HR.
		EXH8	Exhaust	1,260	24 HR.
9	Operating Rooms 3&4	BL9	SUpply	1,880	24 HR.
		EXH9	Exhaust	1,830	24 HR.
10	Operating Rooms 5&6	BL10	Supply	2,260	24 HR.
		EXH10	Exhaust	2,310	24 HR.
11	Minor Operating Room	BL11	Supply	1,260	24 HR.
		EXH11	Exhaust	1,170	24 HR.
12	Central material	BL12	Supply	3,610	24 HR.
		EXH12	Exhaust	4,145	24 HR.
13	Surgical	BL13	Supply	3,395	24 HR.
		EXH13	Exhaust	2,115	24 HR.
14	Recovery	BL14	Supply	1,470	24 HR.
		EXH14	Exhaust	1,915	24 HR.
15	Obstetrical	BL15	Supply	4,140	24 HR.
		EXH15	Exhaust	3,330	24 HR.
16	Nursery	BL16	Supply	3,960	24 HR.
		EXH16	Exhaust	3,820	24 HR.
17 & 18	Wards	BL17	Supply	22,800	24 HR.
		BL18	Supply	18,600	24 HR.
		EXH17	Exhaust	1,750	24 HR.
		EXH18	Exhaust	1,750	24 HR.
		EXH19	Exhaust	32,100	24 HR.
		EXH25	Hood Exhaust	100	24 HR.
		EXH26	Hood Exhasut	500	24 HR.
19	New Clinic	AC1	Supply	27,900	24 HR.
20	New Addition	AC2	Supply	6,300	24 HR.

1700, 1800, 1801 These zones are part of zone 17 and 18 and are uniquely described for specific ECO analyses.

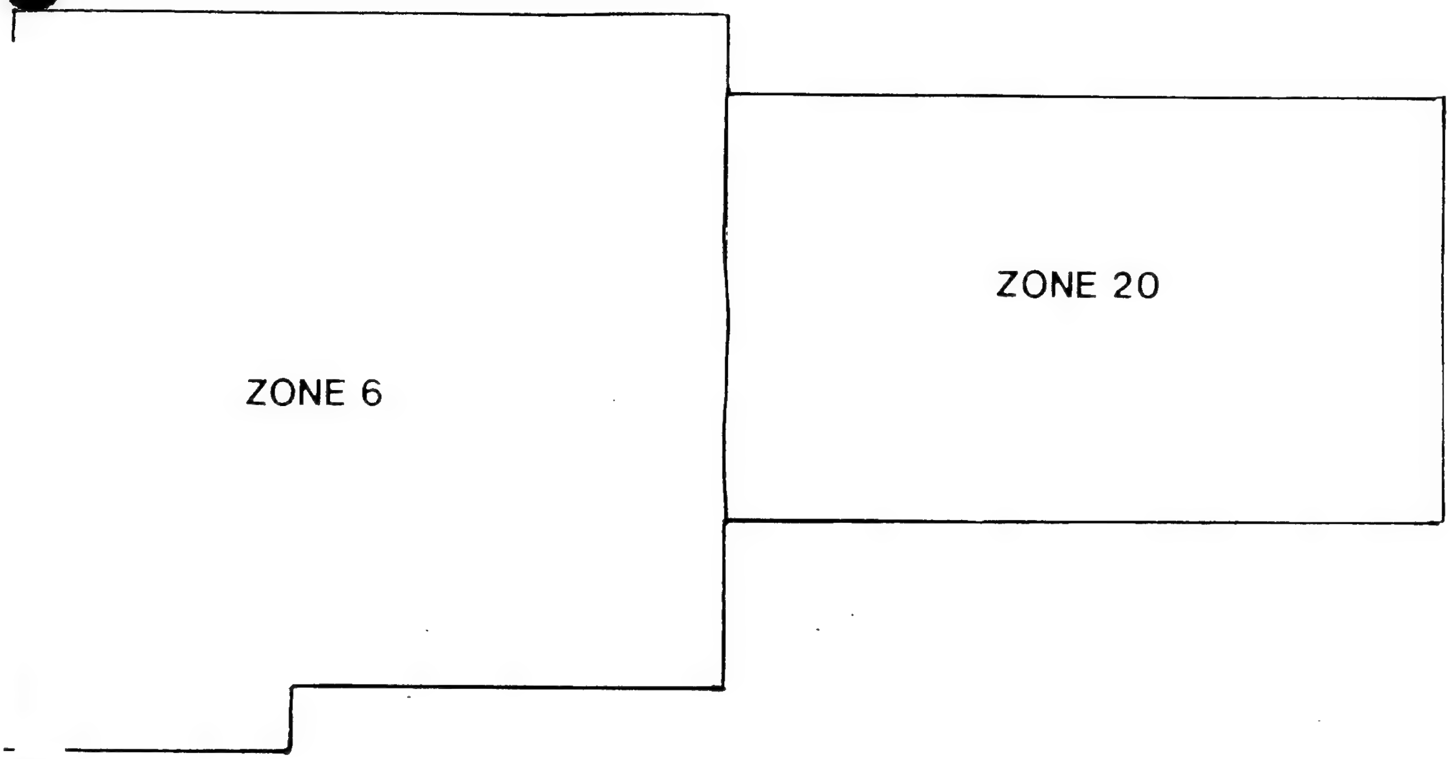

ZONE 2
ZONE 5
ZONE 19
ZONE 1
ZONE 3
BASEMENT (PARTIAL)
MATCH LINE



BASEMENT (PARTIAL)



FIRST FLOOR
(PARTIAL)



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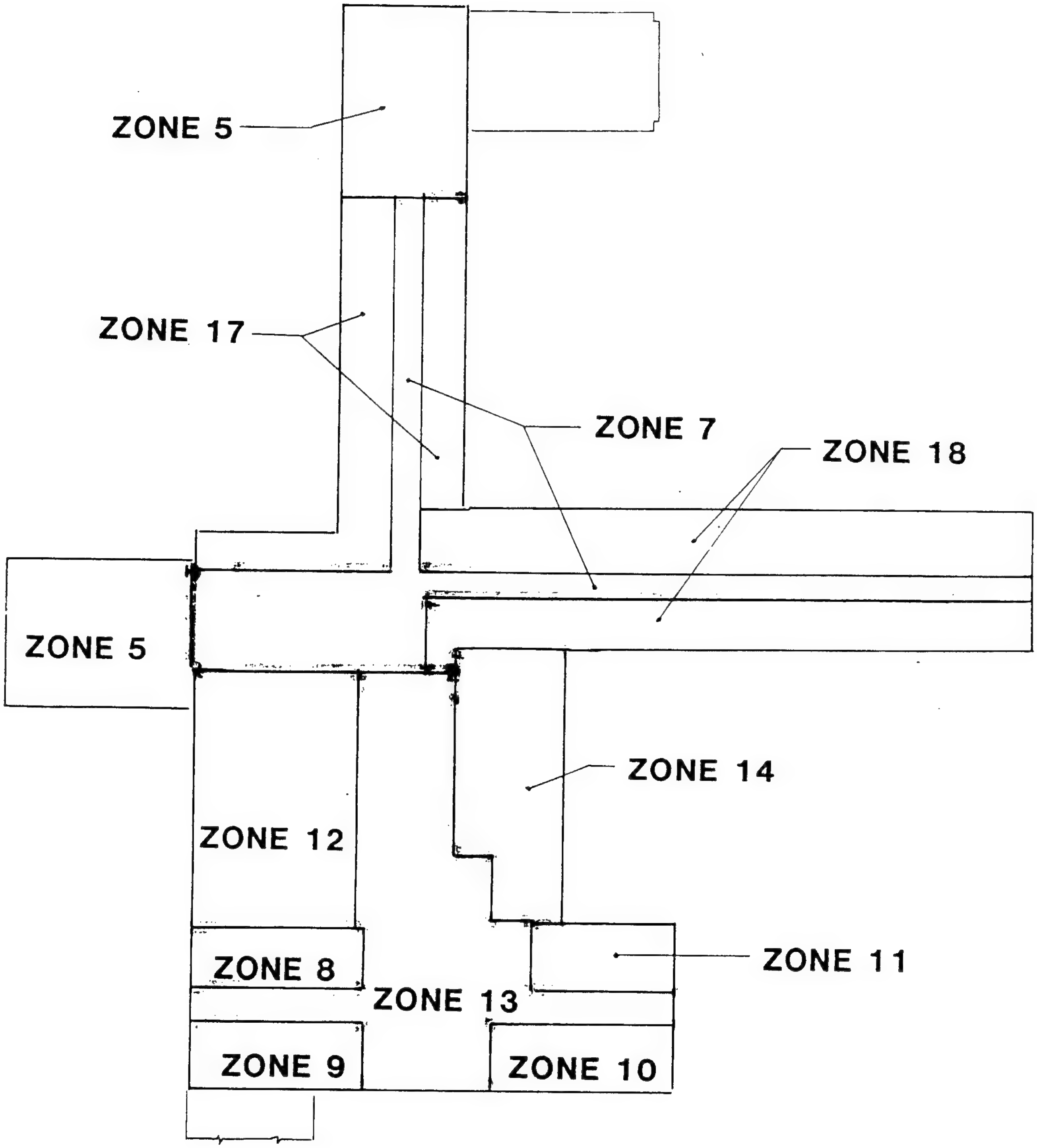
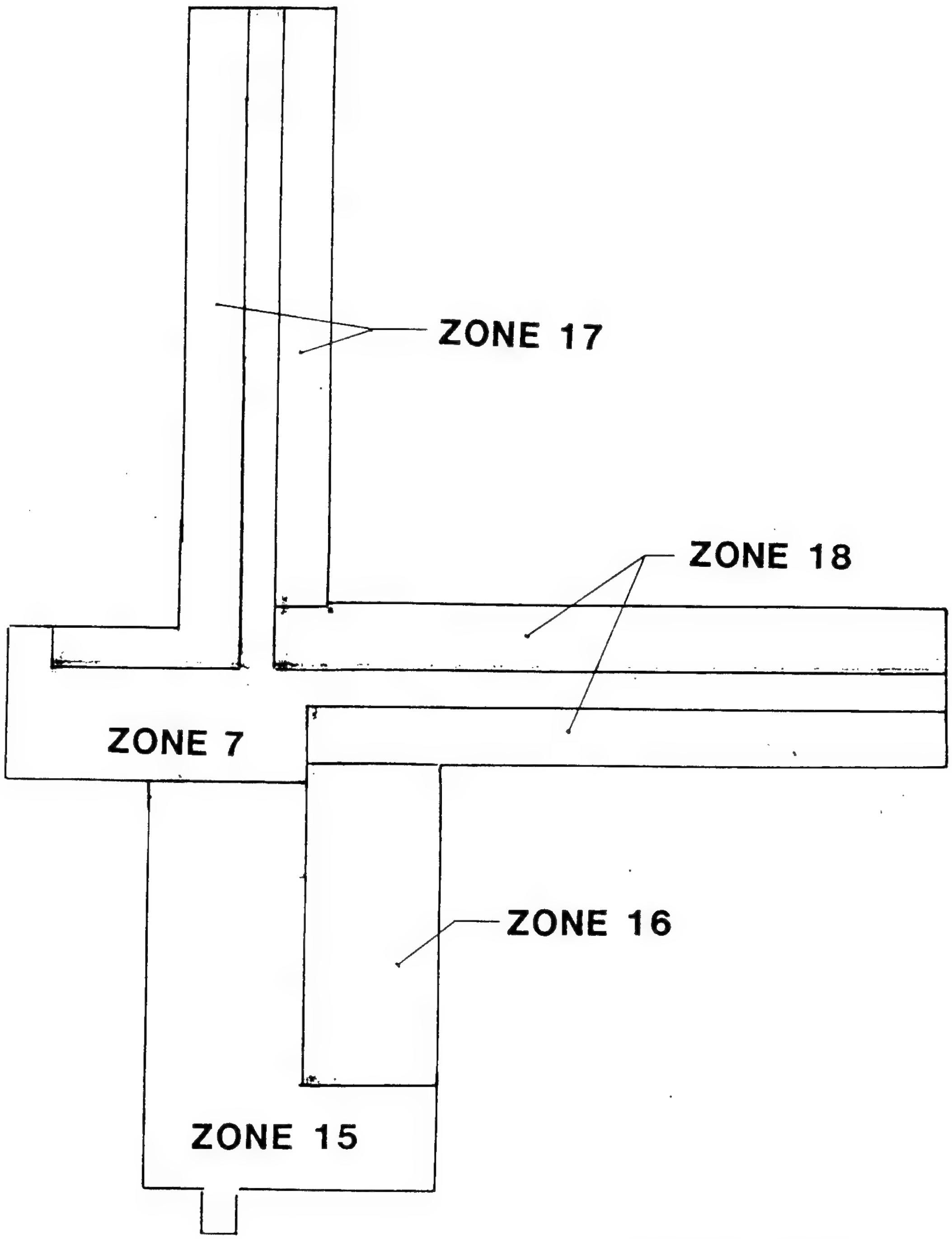
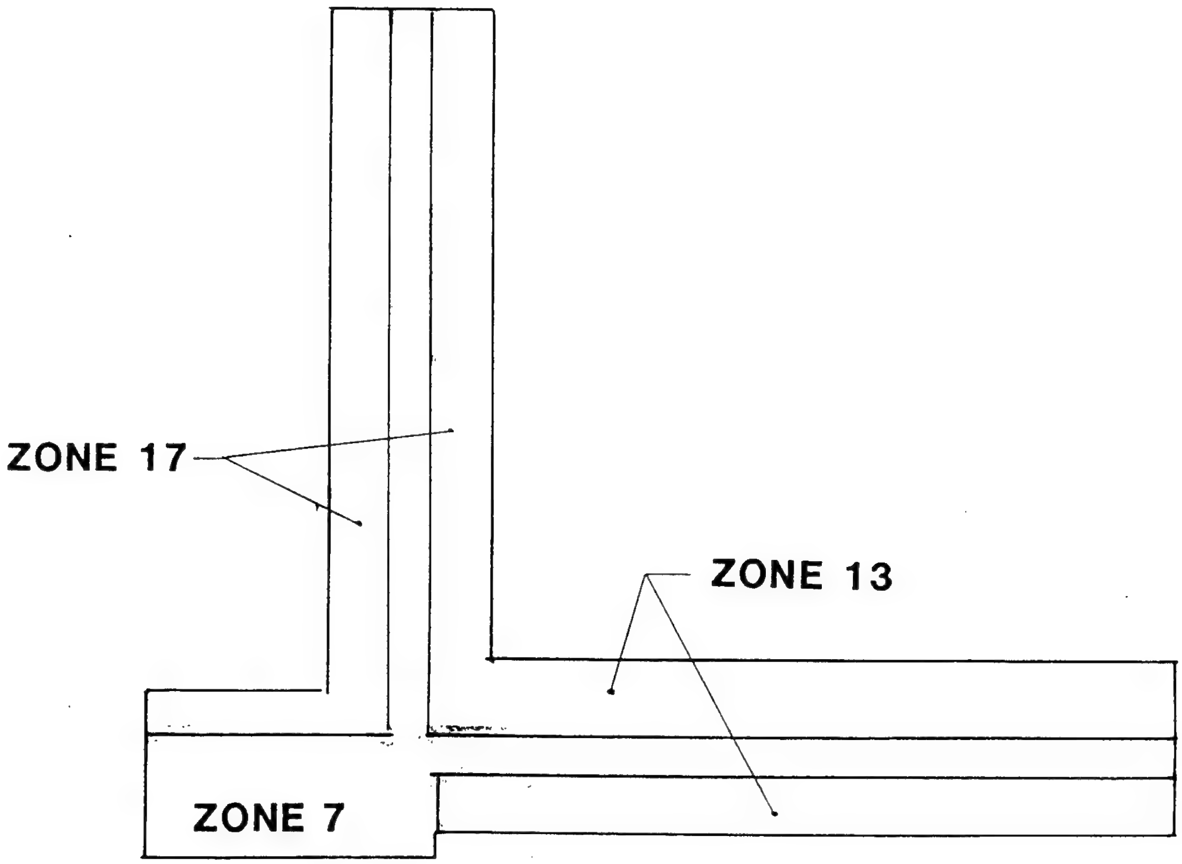


SECOND FLOOR



THIRD FLOOR



FOURTH THROUGH NINTH FLOORS

B. PRESENT ENERGY CONSUMPTION

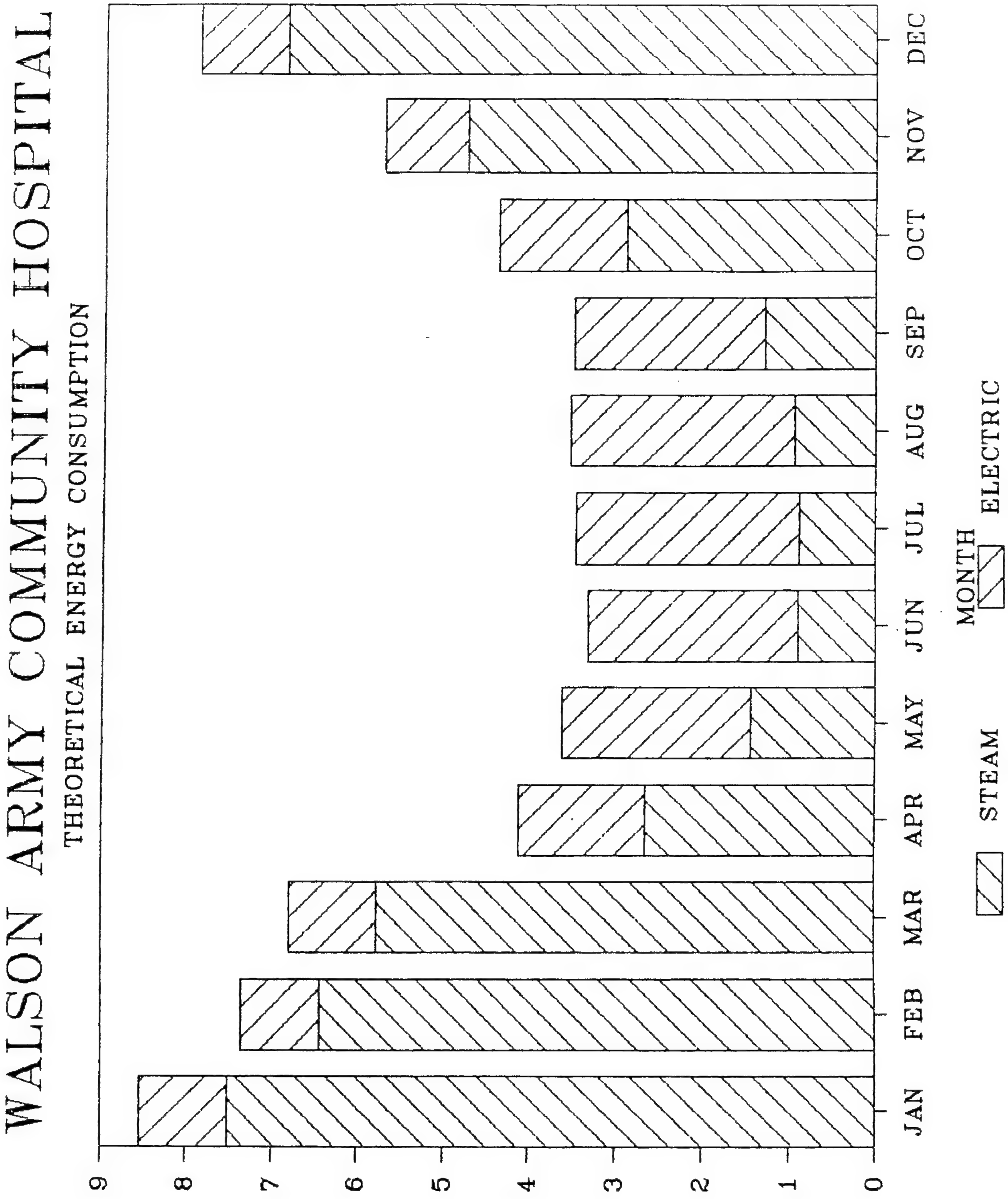
TOTAL ANNUAL ENERGY USED (THEORETICAL)

The annual energy requirements of Walson Army Hospital are presented in the table below and the bar charts on the following pages. The bar charts and load profiles were developed with the Building Loads Analysis and Systems Thermodynamic (BLAST) program. This information is used as a theoretical baseline of energy usage in the analysis of energy conservation measures.

	Steam			Electric		
	MBTU		$	MBTU		$
January	7,516	-	49,015	1,022	-	5,665
February	6,433	-	41,952	920	-	5,100
March	5,779	-	41,952	1,016	-	5,632
April	2,656	-	37,687	1,464	-	8,115
May	1,443	-	9,410	2,179	-	12,078
June	907	-	5,915	2,417	-	13,398
July	884	-	5,765	2,581	-	14,307
August	936	-	6,104	2,593	-	14,373
September	1,282	-	8,360	2,198	-	12,184
October	2,884	-	18,808	1,490	-	8,251
November	4,758	-	31,029	959	-	5,316
December	6,877	-	44,848	1,018	-	5,643
Total	42,355	-	276,215	19,857	-	110,069

Energy rates used in the economic analysis of each energy conservation conservation opportunity were provided by DEH, Fort Dix, New Jersey. The rates are as follows:

Electric: $5.5431/MBTU
Fuel Oil: $6.5214/MBTU of Steam
Steam: $8.7387/1,000 lbm steam

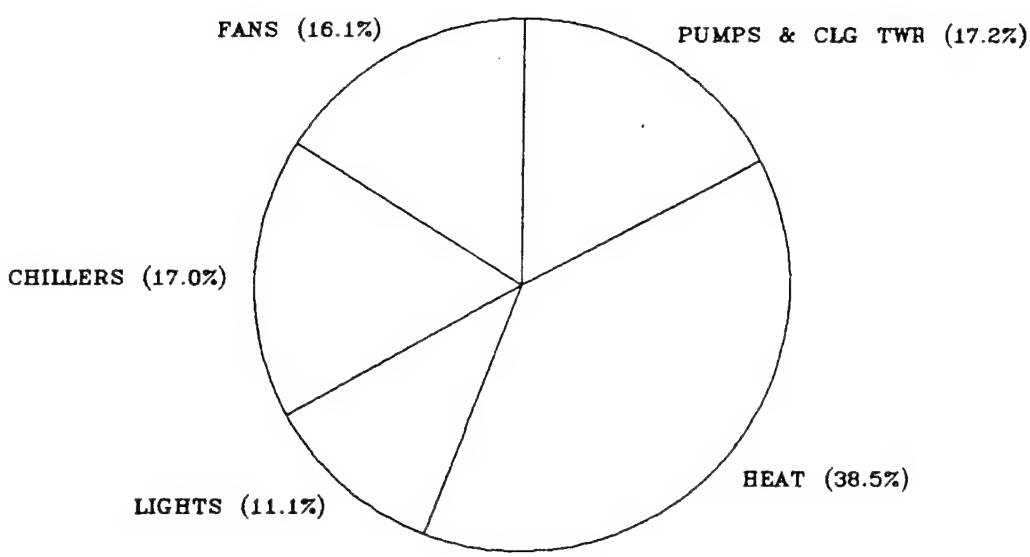


MILLIONS OF BTU
(THOUSANDS)

SOURCE ENERGY CONSUMPTION

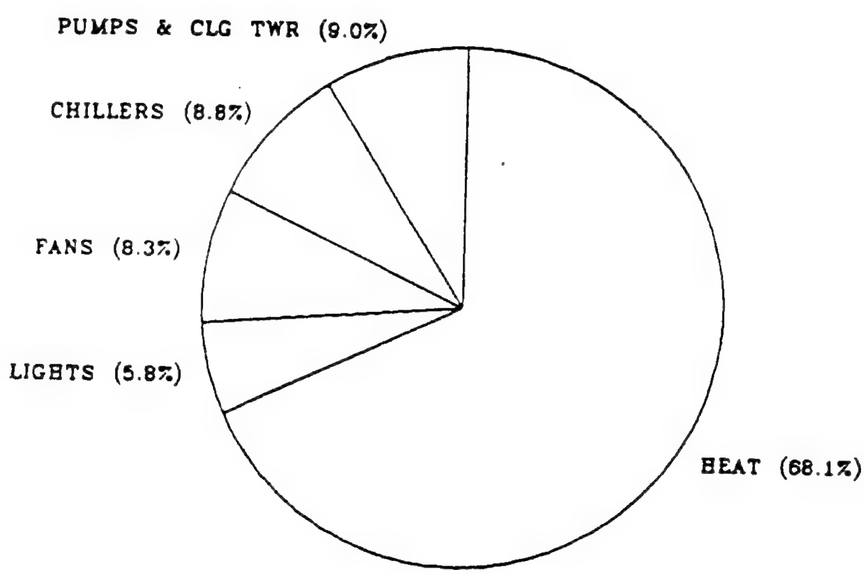
The table and pie chart presented below show a breakout of energy consumption (MBTU) at Walson Army Community Hospital. Information is derived from the BLAST base run output and represents source energy consumption.

	Source (MBTU)	Electric (KWH)	Steam (1,000 lbs)
Heating	42,335		31,593
Lights	12,222	1,053,619	
Fans	17,646	1,521,242	
Chillers	18,690	1,611,192	
Pumps and Cooling Tower	18,931	1,631,995	
Total	109,824	5,818,049	31,593



The table and pie chart presented below show a breakout of energy consumption (BMTU) at Walson Army Community Hospital. Information is derived from the BLAST base run output and represents site energy consumption.

	Site MBTU	Electric (KWH)	Steam (1,000 lbs)
Heating	42,335		31,593
Lights	3,596	1,053,619	
Fans	5,192	1,521,242	
Chillers	5,499	1,611,192	
Pumps and Cooling Tower	5,570	1,631,995	
Total	62,192	5,818,049	31,593



C. HISTORIC ENERGY CONSUMPTION

Electrical consumption for the past three years (FY-82, FY-83, and FY-84) was supplied by DEH, Fort Dix, New Jersey and is presented in the table below and in graphic form on the following page. Historical data on steam consumption is not available.

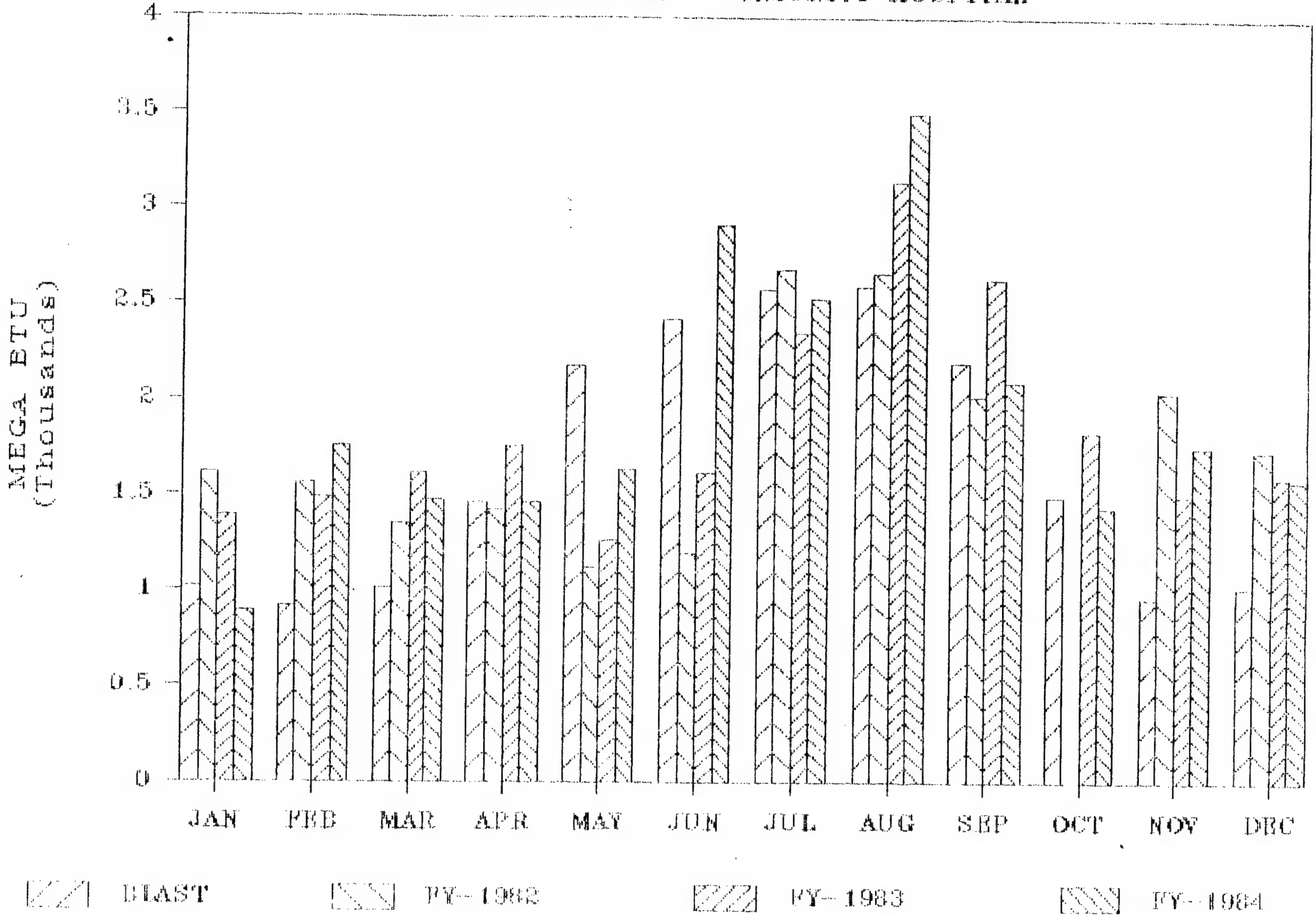
Walson Army Community Hospital Electrical Consumption

	FY-82		FY-83		FY-84	
	MBTU	KWH	MBTU	KWH	MBTU	KWH
O			1,833	537,000	1,434	420,143
N	2,044	598,888	1,499	439,290	1,758	515,000
D	1,735	508,240	1,596	467,697	1,583	463,946
J	1,615	473,225	1,389	407,000	893	261,764
F	1,563	457,882	1,488	435,876	1,755	520,115
M	1,355	397,000	1,614	473,029	1,474	431,923
A	1,421	416,400	1,756	514,560	1,460	427,740
M	1,222	328,845	1,265	370,667	1,633	478,578
J	1,195	350,040	1,612	472,438	2,909	852,420
J	2,679	785,075	2,350	688,634	2,526	740,000
A	2,666	781,200	3,143	921,000	3,502	1,026,000
S	2,018	591,291	2,629	770,370	2,096	614,000
	19,413	5,688,086	22,176	6,497,561	23,023	6,751,629

A comparison between the historical data and the consumption profile developed with BLAST shows a close correlation.

ELECTRICAL ENERGY CONSUMPTION

WALSON ARMY COMMUNITY HOSPITAL



D. ENERGY CONSERVATION ANALYSIS

ENERGY CONSERVATION OPPORTUNITIES RECOMMENDED

In December of 1984 the A/E conducted a field survey of the hospital. At this time they investigated the possibility of each of the ECO's found in Annex A. A checklist was developed to facilitate this survey. The results of the survey are summarized on this checklist and may be found at the end of this report, beginning on page G-74. If an ECO was deemed inappropriate, a brief note explaining why it was dropped from further consideration will be found on the checklist. Any ECO not eliminated by the field survey is discussed further on the following pages.

Due to the lapse in time between the interim submittal and the subsequent review process the Fort Dix and Walson Hospital staff have taken independent action on several of the most promising ECO's. The discussion which follows pertains to our original findings. The table at the top of page D-3 summarizes our original recommendations while the table at the bottom of the page, those ECO's which have yet to have action taken which would represent a significant energy savings to Walson Army Community Hospital.

The following energy conservation opportunities have been recommended based on our December 1984 findings. A detailed analysis of these ECO's can be found on the following pages.

Elevator Room Heat Recovery System: Warm air from elevator shafts and heat from elevator equipment is presently exhausted outdoors by elevator room exhaust systems. This project will provide an elevator room heat recovery system to recover heat from the exhaust fans. Rendered infeasible by actions taken since December 1984.

Heat Recovery System: General exhaust, kitchen exhaust and toilet exhaust systems discharge room temperature air outdoors, without heat reclamation at present time. An equal amount of fresh air is supplied to the building for air handling balance, consuming energy preheating. This project will provide a run-around glycol loop for exhaust systems and the induction unit make-up air system in order to recover the heat from exhausted air and preheat the outside air in the make-up air units.

Low Speed Hood Exhaust: Operating hours of the kitchen and bakery facilities vary with production load and differ from hospital operation. The scheduling of the ventilation equipment is performed by facilities not involved in kitchen operation. This project will provide two speed fan motors and remote controls for cafeteria ventilators in order to allow kitchen personnel to match the ventilation schedule with cafeteria load.

Night Setback: The hospital building is presently equipped with a two pipe inducting system that provides the required heating and cooling. There is currently no provision for night setback. The administrative areas are not occupied around the clock and energy may be saved by reducing night time temperatures to 55° during the heating season.

Bypass Ductwork for O.R.: The existing operating and recovery room air conditioning units operate with 100% outside air in both occupied and unoccupied modes. The current applicable codes allow 75% air recirculation during the unoccupied mode. This project will provide bypass ductwork on all operating and recovery room A/C units in order to recirculate 75% of the air during the unoccupied mode.

Rebalance HVAC Systems: The original HVAC systems have not been balanced since the original installation. Unbalanced air and water flow as well as an excessive amount of outside air supplied to the building increase the energy consumption. This project will rebalance all HVAC systems according to the latest code requirements.

Provide Chilled Water from Main Plant to O.R. Units: The operating room and recovery room air conditioning units are equipped with a self-contained air-cooled chiller. This project will connect chilled water piping from the chiller plant system to the operating and recovery room air conditioning units during the summer months and provide necessary controls in order to utilize the existing air-cooled chiller as stand-by. This will result in lower electric consumption due to the higher efficiency of the central plant chillers.

Summary of Energy and Cost Savings - Recommended based on December 1984 information.

Item	Construction Cost ($)	First Year Savings ($)	Electric Savings (MBTU)	Electric Savings (KWH)	Steam Savings (MBTU)	SIR	SPB
Low Speed Hood Exhaust	4,797	3,352	31	2,672	468	8.19	1.4
Heat Recovery System	67,407	43,721	129	11,212	6,243	7.63	1.5
Elevator Room Heat Recovery	9,361	4,776	(84)	(7,328)	1,018	6.72	2.0
Rebalance HVAC Systems	105,300	68,551	4,887	421,293	3,596	6.71	1.5
Night Setback	8,124	3,841	0	0	589	5.65	2.1
Bypass Ductwork for O.R.	14,517	5,624	68	5,862	847	4.62	2.6
Provide C.W. to O.R.	8,667	3,500	177	15,259	0	3.73	2.5

Summary of Energy and Cost Savings - Recommended on 1987 Conditions

Item	Construction Cost ($)	First Year Savings ($)	Electric Savings (MBTU)	Electric Savings (KWH)	Steam Savings (MBTU)	SIR	SPB
Low Speed Hood Exhaust	4,797	3,352	31	2,672	468	8.19	1.4
Heat Recovery System	67,407	43,721	129	11,212	6,243	7.63	1.5
Rebalance HVAC Systems	105,300	68,551	4,887	421,293	3,596	6.71	1.5
Night Set Back	8,124	3,841	0	0	589	5.65	2.1
Synergistic Effects	185,628	91,371	5,020	432,849	9,744	6.50	1.7

Note: 1 Except where otherwise noted synergistic effects are not considered on these tables.
2 $ based on FY 1988
3 ( ) denotes a negative value

OPPORTUNITIES INVESTIGATED/NOT RECOMMENDED

The following energy conservation opportunities were identified during the field survey. Further analysis has shown them to be uneconomical at this time. A detailed analysis of each opportunity can be found on the following pages.

Install Roof Insulation: Install 3.5 inches of exterior, rigid roof insulation to the hospital roof.

Eliminate Air Leakage: The existing pneumatic control system (controllers and piping) are in poor operating condition, which results in extensive loss of compressed air. Elimination of air leakage from the pneumatic system will result in a reduction of compressor motor electric consumption.

Replace Weatherstripping on all Double Doors: Replace the worn felt insert weatherstripping between all double doors.

Solar Energy Applications: No applications of solar energy appear to be feasible or economical at this time. A quantitive analysis is not required.

Summary of Energy and Cost Savings - Not Recommended

Item	Construction Cost ($)	First Year Savings ($)	Electric Savings (MBTU)	Electric Savings (KWH)	Steam Savings (MBTU)	SIR	SPB
Replace Weatherstripping	979	117	3	259	15	0.96	8.4
Unoccupied Shutdown	206,725	9,932	78	6,724	1,155	0.54	20.9
Eliminate Air Leakage	34,755	424	-0-	-0-	65	0.15	82.3
Roof Insulation	322,335	2,280	126	10,862	181	0.08	141.9

Note: 1. Synergistic effects are not considered in this table.
2. $ based on FY88.

ECIP PROJECTS DEVELOPED

The energy conservation opportunities recommended have been combined and developed into one project and DD 1391. The total investment for this project is $185,628 and will provide $91,371 in annual energy cost savings. Implementation of these measures will provide $63,545 MBTU savings in steam and $5,020 MBTU savings in electric. Complete project documentation for this project has been developed and is separately bound in the Programming Documents Report.

OTHER ENERGY CONSERVATION OPPORTUNITIES

A Final Report was previously prepared by PRC Systems Services Company and submitted under increment F of the Energy Engineering Analysis Program. The report reviews and comments on energy conservation projects proposed by Carter Engineering, Inc. under contract to the General Accounting Office.

This section contains a review and summary of the energy conservation measures recommended in this past study. Where applicable, back-up calculations from the previous study have been included in the appendix to this report.

Eight projects have been recommended under increment F of the Energy Engineering Analysis Program and are presented

	Construction Cost	Annual Energy Savings Type	Annual Energy Savings Amount (MBTU)	Dollar Savings	SIR	Simple Payback (Yrs)	Analysis Date
1. Repair/replace steam traps	514	Resid.	3,379	20,544	571.0	0.025	9/9/83
2. Pipe insulation	1,150	Resid.	412	2,500	33.8	0.46	9/9/83
3. Replace incandescent with fluorescent	47,000	Elect.	10,877	60,912	15.2	0.77	9/9/83
4. Condensing unit waste heat recovery		Elect.	-31.6	-176			
	7,574	Resid.	1,197	7,278	13.1	1.07	9/9/83
5. Automatic radiator valves	9,690	Resid.	1,153	7,010	10.0	1.38	9/9/83
6. High efficiency fluorescent lighting	5,221	Elect.	1,489	8,338	5.9	0.63	9/9/83
7. Duct insulation		Elect.	45	258			
	2,670	Resid.	120	730	5.3	2.70	9/9/83
8. Heat recovery at sixth floor		Elect.	-322	-1,803			
	106,670	Resid.	3,178	19,322	2.3	6.09	9/9/83

1. <u>Repair/Replace Steam Traps</u> - Install heat sensitive strips on 200 steam traps. The heat sensitive strips will enable earlier discovery of trap failures and earlier repair. Status: This energy conservation measure has not been implemented.

2. <u>Pipe Insulation</u> - Repair or replace all defective pipe insulation. Status: This measure is being undertaken by base maintenance personnel on an ongoing basis.

3. <u>Replace Incandescent with Fluorescent</u> - Replace the incandescent fixtures, located primarily in the corridors, with fluorescent fixtures and energy efficient fluorescent lamps. Status: Incandescent fixtures are gradually being replaced with fluorescent fixtures as funds allow.

4. <u>Condensing Unit Waste Heat Recovery</u> - Provide a heat recovery system to recover heat from the ten water-cooled condensing units in the basement. These units presently dump all cooling water to the drain and operate all year long to cool the kitchen equipment. Status: This energy conservation measure has not been implemented.

5. <u>Automatic Radiator Valves</u> - Install 114 self-contained automatic radiator valves to reduce overheating. Heating in the wings is presently controlled by a single zone thermostat. Status: Self-contained radiator valves are gradually being installed as funds allow.

6. <u>High Efficiency Fluorescent Lighting</u> - Replace 3,756 four ft. 40 watt fluorescent tubes with 34 watt fluorescent tubes and new low power factor ballasts. Status: Energy efficient 34 watt tubes are currently not installed at Walson Army Community Hospital.

7. <u>Duct Insulation</u> - Repair all duct insulation failures. Through years of use and abuse, many sheet metal ducts are now bare. Status: This energy conservation measure has not been implemented.

8. <u>Heat Recovery at Sixth Floor</u> - Provide a heat recovery system to recover heat from air exhausted by nine fans at the sixth floor. The recovered heat can be used in the nearby outside air intakes for six air handlers. Status: This energy conservation measure has not been implemented. Similar heat recovery options are analyzed in this report as an alternative to this measure.

ENERGY SAVING PROJECTS NOT ANALYZED

Energy Monitoring and Control System

As a part of this overall review of the Walson Army Community Hospital Energy using system, the A/E has considered the capabilities of the new EMCS.

In most hospital installations the EMCS is not cost effective strictly from an energy savings point of view. This results from the limited scheduling possibilities due to the twenty-four hour nature of much of the space and use. This in no way detracts from the many other non-conservation functions of the EMCS.

The most current information available to the A/E indicates the system is a rather complete monitoring and control system. The updated points list (pages D-10 to D-17) indicates control points for the following:

- o scheduled start/stop
- o optimum start/stop
- o duty cycling
- o demand limiting
- o summer/winter changeover
- o day/night setback
- o economizer control
- o ventilation/recirculation
- o hot/cold deck reset
- o hot water outside air reset
- o chiller optimization
- o chilled water reset

Based on this review no changes are recommended for the EMCS.

BLDG. DESCR. HOSPITAL

BLDG. CAT. NO.

BLDG. NO. 5250

KITCHEN SUB-BSMT M.E.R.

SYSTEM	POINT DESCRIPTION	Control Relay	[illegible]	[illegible]	[illegible]	Damper/Valve Control	Set Point Adjustment	[illegible] Adjustment	[illegible]	Differential Pressure Switch	Flow Switch	Auxiliary Contact	Pulse	Zero Speed Switch	Temperature Degrees-F.	% Relative Humidity	PSIg, PSIa, PSId	Position	Flow
VAC. (G) -20,21 (SCHEM #6)	SUPPLY FAN	2								2									
FAN (G) 20,21 (SCHEM #6)	EXH. FAN	2								2									
	CONDENSATE RTN H. LEVEL											1							

POINT DESCRIPTION	Contact Closure	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Summer/Winter	Day/Night Setback	Economizer	Enthalpy	Ventilation/Recirculation	Hot/Cold Deck Reset	Reheat Coil Reset	Steam Boiler Optimization	Hot Water Boiler Optimization	HW OA Reset	Chiller Optimization	Chilled Water Reset	Condenser Water Reset	Chiller Demand Limit	Lighting Control	Failure Mode *
SUPPLY FAN	2			2	X																			N
EXH. FAN	2			2	X																			N
CONDENSATE RTN H. LEVEL	1	1																						

DWG. #7705-3857 FOR SCHEMATIC #
PROVIDE GRAPHIC DISPLAY

* C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE N - LOCAL LOOP

BLDG. DESCR. HOSPITAL

BLDG. CAT. NO.

BLDG. NO. 5250

BASEMENT M.E.R. 'B'

System	Point Description	Output from EMCS – Digital	Output Digital	Output Digital	Output Digital	Output Digital: Control	Output Analog: Set Point Adjustment	Output Analog: Position Adjustment	Output Analog	Output Analog	Input to EMCS – Digital	Input Digital: Pressure Sw.	Flow Switch	Auxiliary Contact	Pulse	Zero Speed Switch			Input Analog: Temperature Degrees-F.	% Relative Humidity	PSIg, PSIa, PSId	Position	Flow	Alarms Digital: Contact Closure			Alarms Analog: High Limit	Low Limit	Run Time		Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting		Summer/Winter	Day/Night Setback	Economizer	Enthalpy	Ventilation/Recirculation	Hot/Cold Deck Reset	Reheat Coil Reset	Steam Boiler Optimization	Hot Water Boiler Optimization	HW OA Reset	Chiller Optimization	Chilled Water Reset	Condenser Water Reset	Chiller Demand Limit	Lighting Control		Failure Mode *
(G)	HW PUMP	2										2												2					2		X	X					X								X							N
	HW SUPPLY						1												1								1	1																								C
+EM #3)	HW RETURN																		1								1	1																								
AM	PRY. ALARM										1													1																												
	(SEE GEN'L NOTE 2)																																																			
AC (G)	SUPPLY FAN	6										6												6					6		X	X	X	X			X	X														N
-1,2,3,4,5,6	SPACE																		6								6	6																								
HEM #2)	SUPPLY AIR						6												6								6	6																								C
	WARM UP/COOL DN					6																																X		X												N
	COOLING VALVE																					6																								X	X					
FAN (G)																																																				
6, 27, 28	EXH. FAN	4										4												4					4		X	X	X	X																		N
M. #2)																																																				
3 (G)																																																				
HEM #8)	CHW PUMPS	4										4												4					4		X	X				X																N
	CHW S+R TEMP.																		2								2	2																								
	SEC. PUMPS	2										2												2					2		X					X																N
	SEC. S+R. TEMP.																		2								2	2																								

E DWG. # 7705-3857 FOR SCHEMATIC #

PROVIDE GRAPHIC DISPLAY

* C - LAST COMMAND   O - ON (OPEN)
H - HIGH VALUE   F - OFF (CLOSED)
L - LOW VALUE   N - LOCAL LOOP

D-11'

...DG. DESCR. HOSPITAL

...DG. CAT. NO.

...DG. NO. 5250

4th FLOOR M.E.R.

SYSTEM	POINT DESCRIPTION	Output Digital [illegible]	Output Digital [illegible]	Output Digital [illegible]	Output Digital [illegible]	Output Digital [illegible]	Output Analog Cont[illegible]	Output Analog Position[illegible]	Input Digital: Differential Pressure Switch	Flow Switch	Auxiliary Contact	Pulse	Zero Speed Switch	Input Analog: Temperature Degrees-F.	% Relative Humidity	PSIg, PSIa, PSId	Position	Flow	Alarms Digital: Contact Closure	Alarms Analog: High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Summer/Winter	Day/Night Setback	Economizer	Enthalpy	Ventilation/Recirculation	Hot/Cold Deck Reset	Reheat Coil Reset	Steam Boiler Optimization	Hot Water Boiler Optimization	HW OA Reset	Chiller Optimization	Chilled Water Reset	Condenser Water Reset	Chiller Demand Limit	Lighting Control	Failure Mode *
... (G)																																										
...8,9,12,13,16	SUPPLY FAN	5							5										5			5	X	X	X	X		X	X													N
...HEM #2)	ZONE SPACE													5						5	5																					
	SUPPLY AIR						5							5						5	5																					
	WARM UP/COOL DN					5																							X		X											C
	COOLING VALVE																5																				X	X				N
...FANS (G)																																										
...8,9,15,16	EXH. FAN	4							4										4			4	X	X	X	X																N
...HEM #2)																																										

...NG # 7705-3857 FOR SCHEMATIC #

PROVIDE GRAPHIC DISPLAY

* C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE N - LOCAL LOOP

I/O SUMMARY TABLE

BLDG. DESCR. HOSPITAL

BLDG. CAT. NO.

BLDG. NO. 5250

5TH FLOOR M.E.R.

SYSTEM	POINT DESCRIPTION	OUTPUT DIGITAL [illegible]	OUTPUT DIGITAL [illegible]	OUTPUT DIGITAL [illegible] Auto	OUTPUT DIGITAL [illegible]	OUTPUT DIGITAL [illegible] Control	OUTPUT ANALOG [illegible]	OUTPUT ANALOG [illegible]	OUTPUT ANALOG [illegible]	INPUT DIGITAL Differential Pressure Switch	INPUT DIGITAL Flow Switch	INPUT DIGITAL Auxiliary Contact	INPUT DIGITAL Pulse	INPUT DIGITAL Zero Speed Switch	INPUT ANALOG Temperature Degrees-F.	INPUT ANALOG % Relative Humidity	INPUT ANALOG PSIg, PSIa, PSId	INPUT ANALOG Position	INPUT ANALOG Flow	ALARMS DIGITAL Contact Closure	ALARMS ANALOG High Limit	ALARMS ANALOG Low Limit	ALARMS ANALOG Run Time	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Summer/Winter	Day/Night Setback	Economizer	Enthalpy	Ventilation/Recirculation	Hot/Cold Deck Reset	Reheat Coil Reset	Steam Boiler Optimization	Hot Water Boiler Optimization	HW OA Reset	Chiller Optimization	Chilled Water Reset	Condenser Water Reset	Chiller Demand Limit	Lighting Control	Failure Mode *
(6) 7, [illegible], 11, 14, 15 [illegible] TOP AC UNIT (SCHEM #2)	SUPPLY FAN	6								6										6			6	X	X	X	X		X	X													N
	ZONE SPACE														6						6	6																					
	SUPPLY AIR						6								6						6	6																					C
	WARMUP/COOL DN					6																								X		X											N
	COOLING VALVE																	6																				X	X				
FANS (6) [illegible] 11, 12, 13, 14 [illegible] 7, 18 (SCHEM #2)	EXH. FAN	7								7										7			7	X	X	X	X																N

[illegible] DWG # 7705-3857 FOR SCHEMATIC #

[illegible] PROVIDE GRAPHIC DISPLAY

* C - LAST COMMAND   O - ON (OPEN)
H - HIGH VALUE   F - OFF (CLOSED)
L - LOW VALUE   N - LOCAL LOOP

[illegible] TABLE

SHEET 12 OF 46

BLDG. DESCR. HOSPITAL	
BLDG. CAT. NO.	
BLDG. NO. 5250	
9th FLOOR M.E.R. / ROOF	

HARDWARE

SYSTEM	POINT DESCRIPTION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Control Point Adjustment	Position Adjustment	[illegible]	[illegible]	[illegible]	Differential Pressure Sw.	Flow Switch	Auxiliary Contact	Pulse	Zero Speed Switch			Temperature Degrees-F.	% Relative Humidity	PSIg, PSIa, PSId	Position	Flow
..C (G)	SUPPLY FAN	2										2											
..7,18	ZONE SPACE																		4				
..CM # 2)	SUPPLY AIR						2												2				
	WARM UP / COOL DN					2																	
	COOLING VALVE																					2	
(FANS ..)	EXH. FANS	5										5											
.. 3, 4, 7, 19																							
..EM 2)																							
	OUTSIDE AIR																		1				

SOFTWARE

POINT DESCRIPTION	Contact Closure			High Limit	Low Limit	Run Time		Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting		Summer/Winter	Day/Night Setback	Economizer	Enthalpy	Ventilation/Recirculation	Hot/Cold Deck Reset	Reheat Coil Reset	Steam Boiler Optimization	Hot Water Boiler Optimization	HW OA Reset	Chiller Optimization	Chilled Water Reset	Condenser Water Reset	Chiller Demand Limit	Lighting Control		Failure Mode *
SUPPLY FAN	2					2		X	X	X	X			X	X														N
ZONE SPACE				4	4																								
SUPPLY AIR				2	2																								C
WARM UP / COOL DN															X		X												N
COOLING VALVE																							X	X					
EXH. FANS	5					5		X	X	X	X																		N
OUTSIDE AIR																													

DWG # 7705-3857 FOR SCHEMATIC *
PROVIDE GRAPHIC DISPLAY

* C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE N - LOCAL LOOP

I/O SUMMARY TABLE

SHEET 43 OF 46

BLDG. DESCR. HOSPITAL

BLDG. CAT. NO.

BLDG. NO. 5250

AIR EVACUATION WING

SYSTEM	POINT DESCRIPTION	[illegible] DIGITAL					[illegible] ANALOG				INPUT TO EMCS DIGITAL						INPUT TO EMCS ANALOG					ALARMS DIGITAL
												Differential Pressure Switch	Flow Switch	Auxiliary Contact	Pulse	Zero Speed Switch	Temperature Degrees-F	% Relative Humidity	PSIg, PSIa, PSId	Position	Flow	Contact Closure
... HW (G) CONVERTER (... #1)	HW PUMPS	3										2										3
	HW SUPPLY						2										3					
... (... CHEM #3)	PRY ALARM (SEE GENL NOTE 2)										1											1
... UNIT UL-23 (... CHEM #7)	SUPPLY FAN	1										1										1
	ZONE SPACE																4					
	HOT & COLD DECK						2										2					
	WARM UP/COOL DN					1																
	REFRIG COMP.	1												1								1

POINT DESCRIPTION	ALARMS ANALOG High Limit	Low Limit	Run Time	APPLICATION PROGRAMS Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Summer/Winter	Day/Night Setback	Economizer	Enthalpy	Ventilation/Recirculation	Hot/Cold Deck Reset	Reheat Coil Reset	Steam Boiler Optimization	Hot Water Boiler Optimization	HW OA Reset	Chiller Optimization	Chilled Water Reset	Condenser Water Reset	Chiller Demand Limit	Lighting Control	Failure Mode *
HW PUMPS			3	X	X				X								X						N
HW SUPPLY	3	3							X								X						C
PRY ALARM (SEE GENL NOTE 2)																							
SUPPLY FAN			1	X	X	X	X		X														N
ZONE SPACE																							
HOT & COLD DECK																							C
WARM UP/COOL DN										X		X											N
REFRIG COMP.			1	X	X			X															N

... DWG # 7705-3857 FOR SCHEMATIC #

... PROVIDE GRAPHIC DISPLAY

* C - LAST COMMAND, H - HIGH VALUE, L - LOW VALUE, O - ON (OPEN), F - OFF (CLOSED), N - LOCAL LOOP

... SUMMARY TABLE

SHEET 44 OF 46

... HOSPITAL

... NO.

... NO. 5250

CLINIC WING

SYSTEM	POINT DESCRIPTION	[illegible]	[illegible]	[illegible]	[illegible]	Input to EMCS – Digital – [illegible]	Input to EMCS – Analog – Temperature (Degrees F)	Input to EMCS – Analog – Position	Alarms – Digital – Contact Closure	Alarms – Analog – High Limit	Alarms – Analog – Low Limit	Alarms – Analog – Run Time	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Day/Night Setback	Economizer	Ventilation, Recirculation	Hot/Cold Deck Reset	HW OA Reset	Chiller Optimization	Chilled Water Reset	Failure Mode *
...AM/H... (6) ...VERTER (...EM #3)	~~HW~~ PUMPS	5				5			5			5	X	X			X				X			N
	HW SUPPLY		5				5			5	5						X				X			C
...(6) (...M #1)	PRV ALARM (SEE GEN'L NOTE 2)				1				1															
...UNIT ...-22 (6) (...EM #1)	SUPPLY FAN	1				1			1			1	X	X	X	X								N
	ZONE SPACE						1																	
	HOT & COLD DECK		2				2													X				C
	WARMUP/... ON			1														X	X					N
	~~H~~/LO SPACE TEMP						2			2	2									X				
	COOLING VALVE							1														X	X	

...DWG #7705-3857 FOR SCHEMATIC #

...PROVIDE GRAPHIC DISPLAY

* C - LAST COMMAND H - HIGH VALUE L - LOW VALUE O - ON (OPEN) F - OFF (CLOSED) N - LOCAL LOOP

... TABLE

SHEET ... OF 46

Ice Storage

Our scope of work did not include a survey or analysis of the chilled water plant serving the hospital.

During a brief walk-through of the plant, however, a potential opportunity for significant energy savings was discovered. The existing chilled water plant consists of two 500-ton centrifugal chillers. The chillers are presently operated primarily during the day when the electric consumption rate is $.06/Kwh and electric demand is at a maximum. A considerable savings in energy costs may be realized utilizing an ice storage concept in the existing operation.

The concept of ice storage is rapidly regaining popularity. Utility companies are consistently raising their rates, especially demand charges. Consequently, many air conditioning designers are shifting power requirements to nighttime consumption in order to utilize off-peak rates ($.04/Kwh at Fort Dix) and to avoid daytime demand penalties. Ice storage equipment is designed to form ice on the surface of the evaporator tubes and to store it until chilled water is needed for cooling. During the daytime, the ice is melted, providing the chilled water necessary for air conditioning.

The expected energy cost reduction will consist of:

- Off-peak electric rate at nighttime.
- Reduced demand charges during the daytime.
- Operation of the chillers at full load and at maximum efficiency.

We recommend that an additional study be undertaken to determine the feasibility of this option.

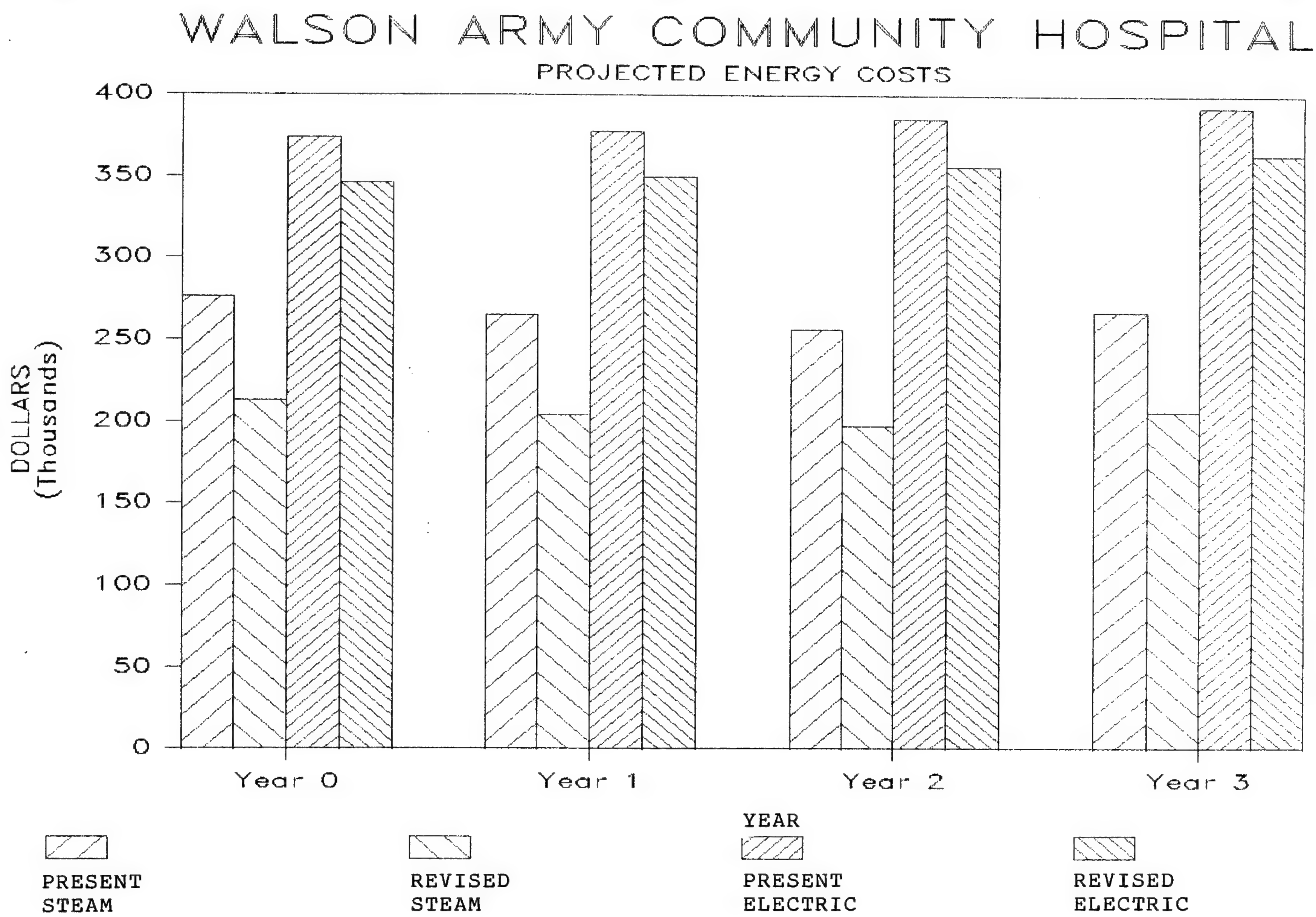
E. ENERGY AND COST SAVINGS

Each energy conservation opportunity investigated has been evaluated independently, i.e., possible duplication of savings between related projects is not considered. In addition, the recommended energy conservation opportunities have been analyzed for synergistic effects. The results of the synergistic evaluation are presented in this section.

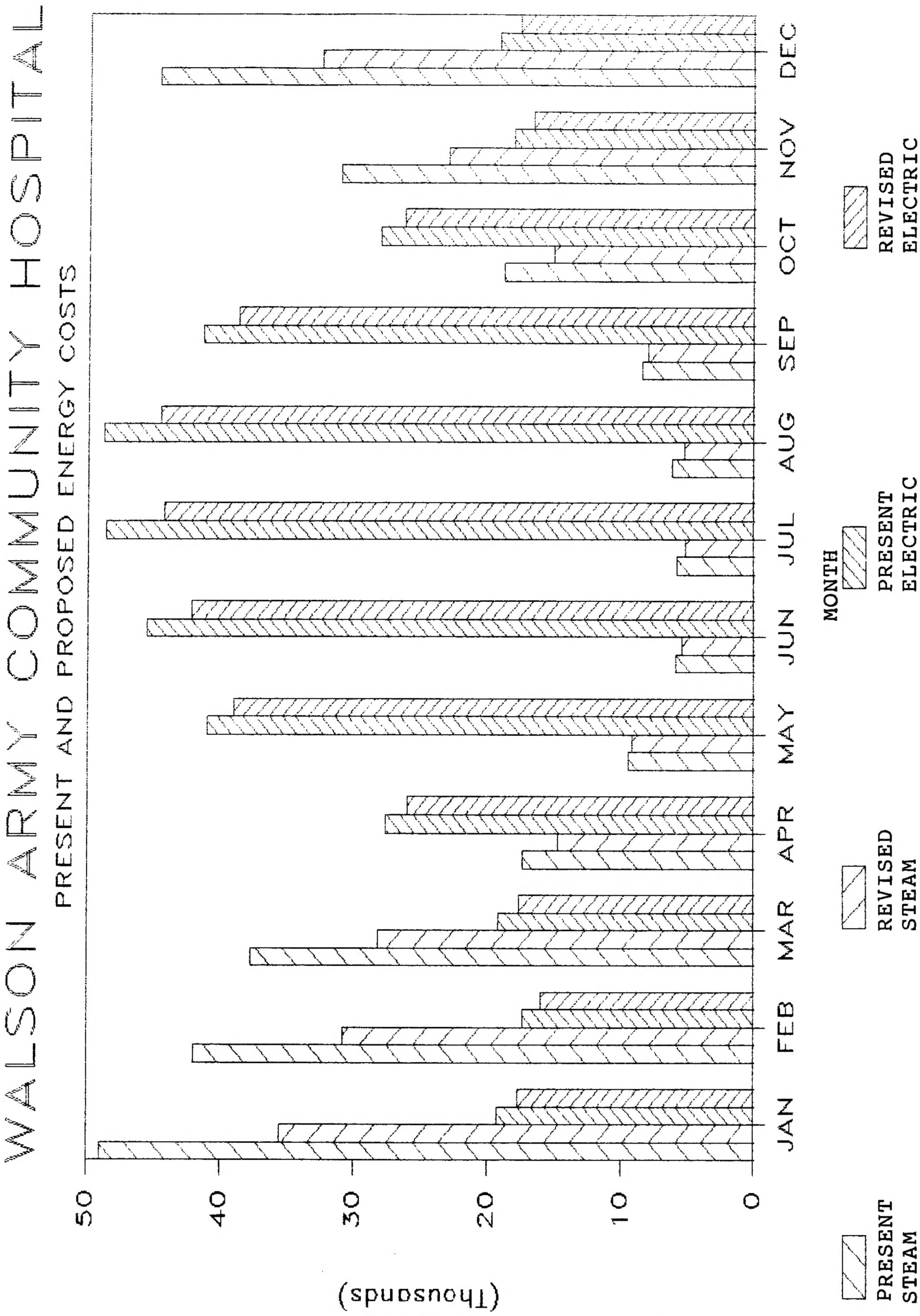
Energy savings were determined by computing the baseline BLAST analysis with a similar analysis with the appropriate individual ECO input changes having been made. The synergistic energy savings were determined by computing the baseline BLAST run to a final conditions BLAST run, where all ECO modifications have been modeled.

Implementation of the cost effective energy conservation opportunities recommended in this report will provide a total energy savings of 14,764 MBTUs per year, consisting of 9,744 MBTUs of steam and 5,020 of electricity. The total annual cost savings will be $91,370. This represents a 20% reduction in energy usage compared to 1984 consumption levels.

The following three graphs provide a comparison of energy consumption, in dollars, between that which is currently used, and the estimated consumption after the implementation of the recommended ECO's. The first graph compares the existing and revised energy consumption on a monthly basis, for one year, showing both steam and electric. The second graph shows a comparison of the electric costs between the existing and revised usage, and projects those costs for a three year period using DOE escalation rates. The third graph is similar to the second graph but shows the differences for the costs associated with steam consumption.



WALSON ARMY COMMUNITY HOSPITAL
PROJECTED ENERGY COSTS
DOLLARS
(Thousands)
400
350
300
250
200
150
100
50
0
Year 0
Year 1
Year 2
Year 3
YEAR
PRESENT STEAM
REVISED STEAM
PRESENT ELECTRIC
REVISED ELECTRIC


WALSON ARMY COMMUNITY HOSPITAL
PRESENT AND PROPOSED ENERGY COSTS
DOLLARS (Thousands)
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTH
PRESENT STEAM
REVISED STEAM
PRESENT ELECTRIC
REVISED ELECTRIC

F. ENERGY PLAN

The energy conservation opportunities recommended in this report have been combined into a single Energy Conservation Project for funding purposes. A form DD1391 Programming Document has been prepared, and is separately bound.

A summary report is presented on the following page. This report provides existing and revised energy consumption data for the combined effect of implementing all recommended energy conservation opportunities. In addition, a life cycle cost analysis is provided for the combined cost effective opportunities.

The overall savings to investment ratio (SIR) is 6.50. The combined simple payback period is 1.7 years.

Summary Report - Combined Cost Effective ECO's

Existing Building

Plant	Site Electric (MBTU)	Steam (MBTU)	Source Electric (MBTU)
10-1	4,285	5,040	14,564
10-2	14,514	36,099	49,330
20	1,058	1,196	3,596
Total	19,857	42,335	67,489

Revised Building

Plant	Site Electric (MBTU)	Steam (MBTU)	Source Electric (MBTU)
10-1	4,285	5,040	14,564
10-2	13,037	26,355	44,310
20	1,058	1,196	3,596
Total	18,380	32,591	62,469

Plant Summary

	Site Electric (MBTU)	Steam (MBTU)	Source Electric (MBTU)
Existing	19,857	42,335	67,489
Revised	18,380	32,591	62,469
Savings	1,477	9,744	5,020

Cost Summary

	Electric Use (K$)	Electric Demand (K$)	Total Electric (K$)	Total Steam (K$)
Existing	374.1	164.8	538.9	276.1
Revised	346.3	143.9	490.2	212.5
Savings	27.8	20.9	48.7	63.5

Fort Dix Energy Audit

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION________ FT. DIX, NEW JERSEY BUILDING NAME--WALSON ARMY COMM. HOSPITAL
REGION NO.______ 2 ECONOMIC LIFE--15 YEARS
PROJECT TITLE___ COMBINED COST EFFECTIVE ECO'S

1. Investment Costs

A.	Construction Cost	$185,628	
B.	SIOH (5 ½%)	$ 10,210	
C.	Design Cost (6%)	$ 11,138	
D.	Energy Credit Calc (1A+1B+1C)X.9	$186,278	
E.	Total Investment		$186,278

2. Energy Savings (+) / Cost (-)
   Analysis Date Annual Savings, Unit Cost & Discounted Savings

FUEL		COST $/MBTU	SAVINGS MBTU/YR	ANNUAL SAVINGS	DISCOUNT FACTOR	DISCOUNTED SAVINGS
A.	Elec	$5.5431	5,020	$27,826	9.72	$270,471
B.	Dist					
C.	Resid	$6,5214	9,744	$63,545	11.99	$761,899
D.	NG					
E.	Coal					
F.	Total		14,764	$91,371	--------	$1,032,370

3. Non Energy Savings (+) / Cost (-)
   A. Annual Recurring (+ / =) $20,874 (Demand Saving)
   -1,292.0 (Maintenance)
      (1) Discount Factor 9.11
      (2) Discounted Saving/Cost 178,390

   B. Non Recurring Savings (+) / Cost (-)

	Item	Savings (+) Cost (-)	Year of Occurrence	Discount Factor	Discounted Savings/Cost
a.					
b.					
c.	TOTAL				

   C. Total Non Energy Discounted Savings (+) / Cost (-) $178,390

   D. Project Non Energy Qualification Test
      (1) 25% Max. Non Energy Calc. (.33 Times Discounted Energy Savings) $340,682
         a. If 3D(1) is Greater Than 3C go to Item 4
         b. If 3D(1) is Less Than 3C Calculates Sir Using 3D - N/A
         c. If 3D1b is Greater Than 1.0 go to Item 4
         d. If 3D1b is Less Than 1.0 Project Does Not Qualify

4. First Year Dollar Savings $110,953

5. Total Net Discounted Savings $1,210,760

6. Discounted Savings Ratio 6.50

7. Simple Payback Period 1.7